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Pitstick

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(54) **SPRING LOADED SELF ACTUATING IMPACT DRIVER**

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(22) Filed: **Jul. 13, 2000**

Related U.S. Application Data

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(51) **Int. Cl.**[7] **B25B 19/00**
(52) **U.S. Cl.** **81/463**; 173/93.6; 173/203
(58) **Field of Search** ..... 81/463, 465, 466, 81/DIG. 2, DIG. 5; 173/93, 93.7, 202, 203, 120, 121, 93.6

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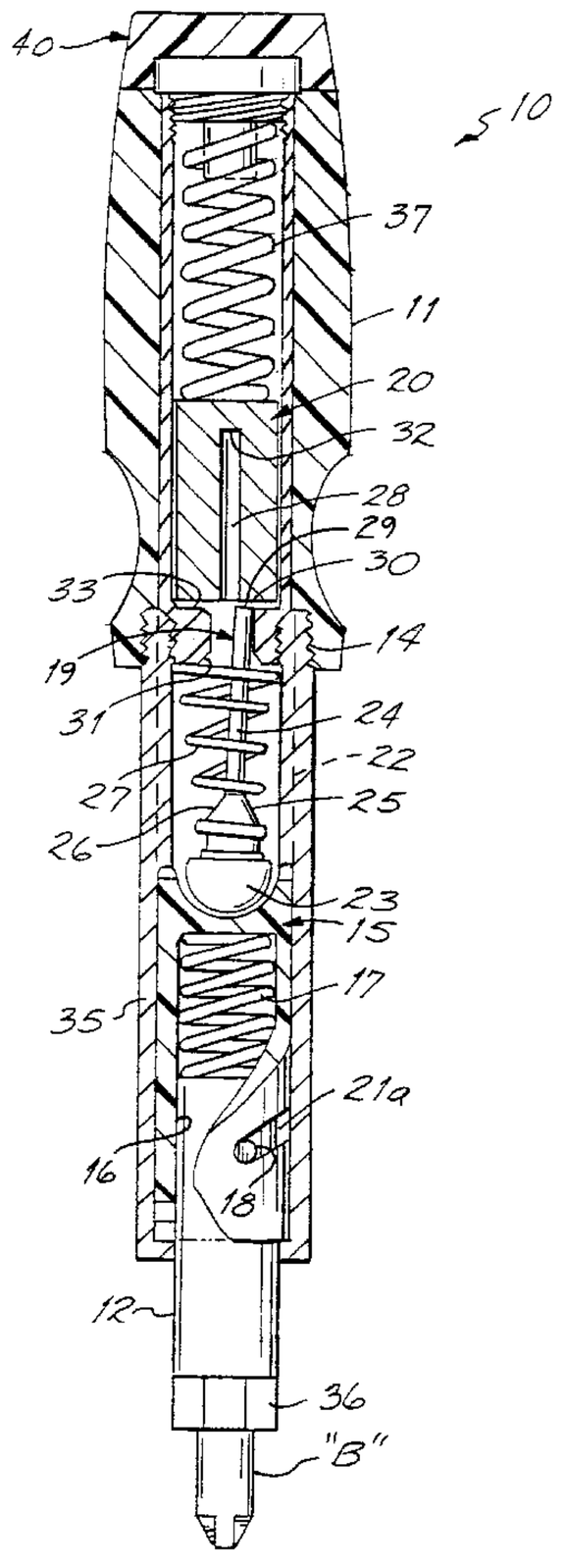
(57) **ABSTRACT**

A self-contained impact driver includes an internal hammer, hammer spring and trigger. Pressing the driver against a fastener compresses the spring progressively until the end of the stroke, at which time the hammer is released by the trigger. The trigger both compresses the hammer spring, and releases it. Rotary impact force is applied to the fastener in a selected clockwise or counterclockwise direction.

9 Claims, 5 Drawing Sheets



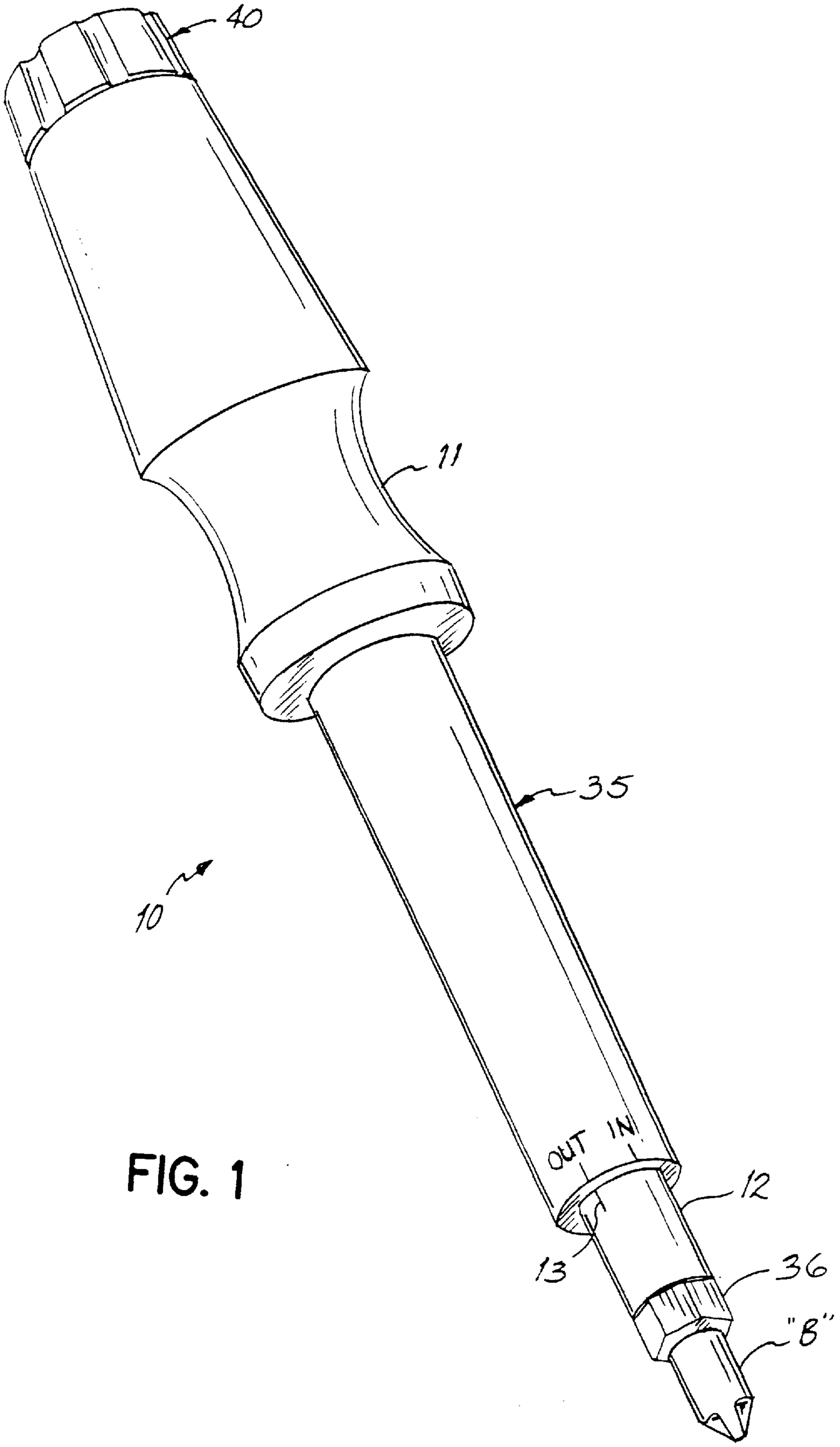


FIG. 1

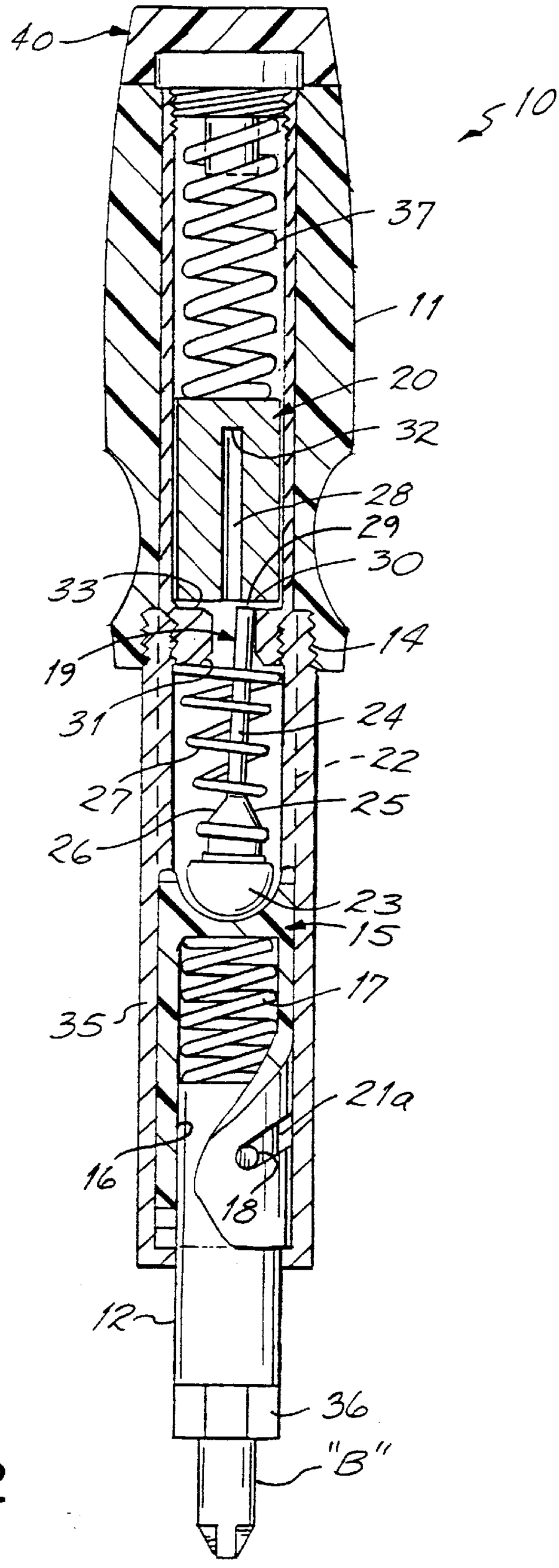

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FIG. 2

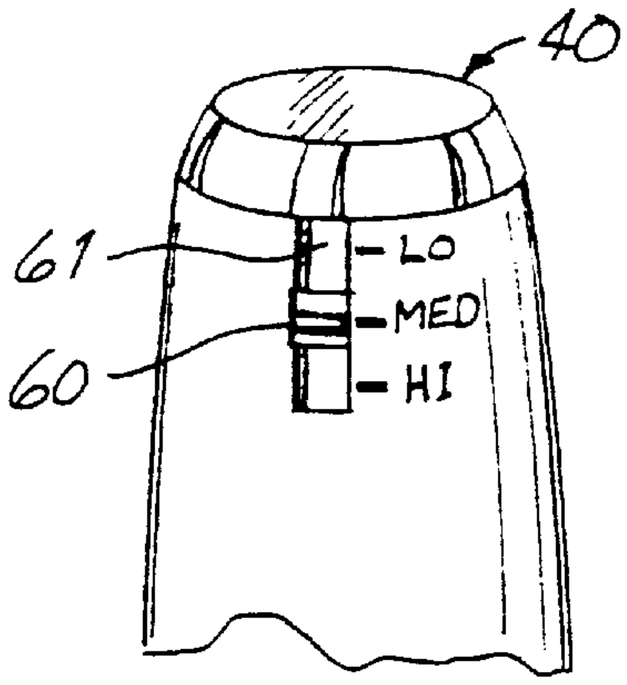

FIG. 3

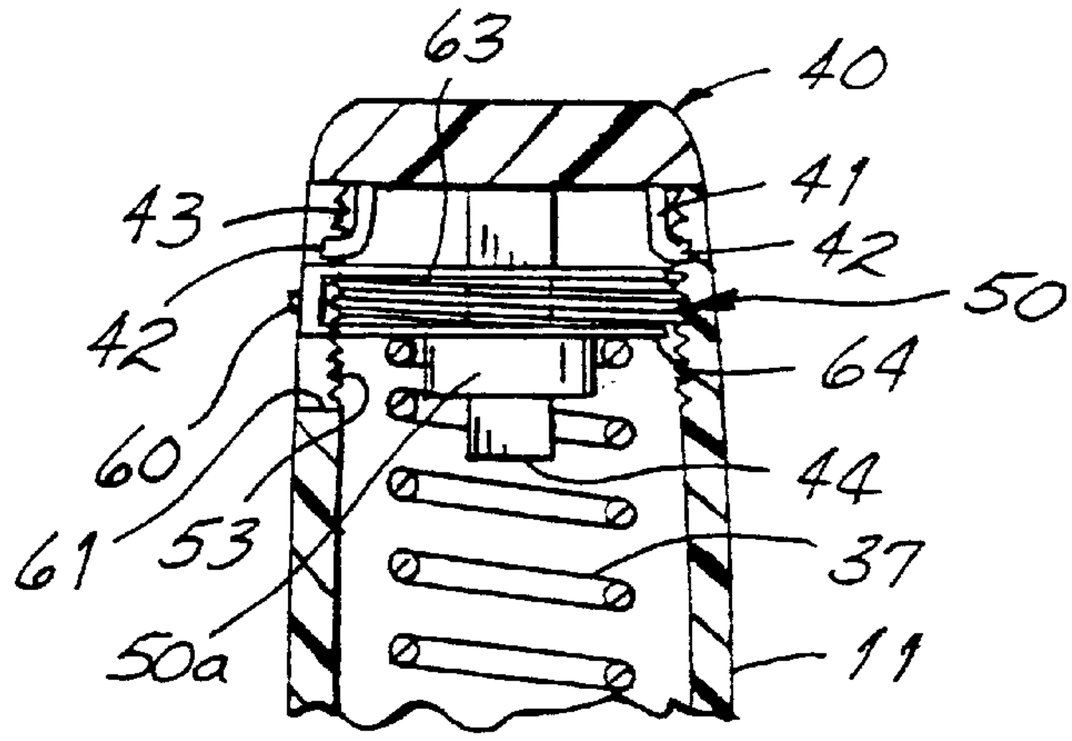

FIG. 4

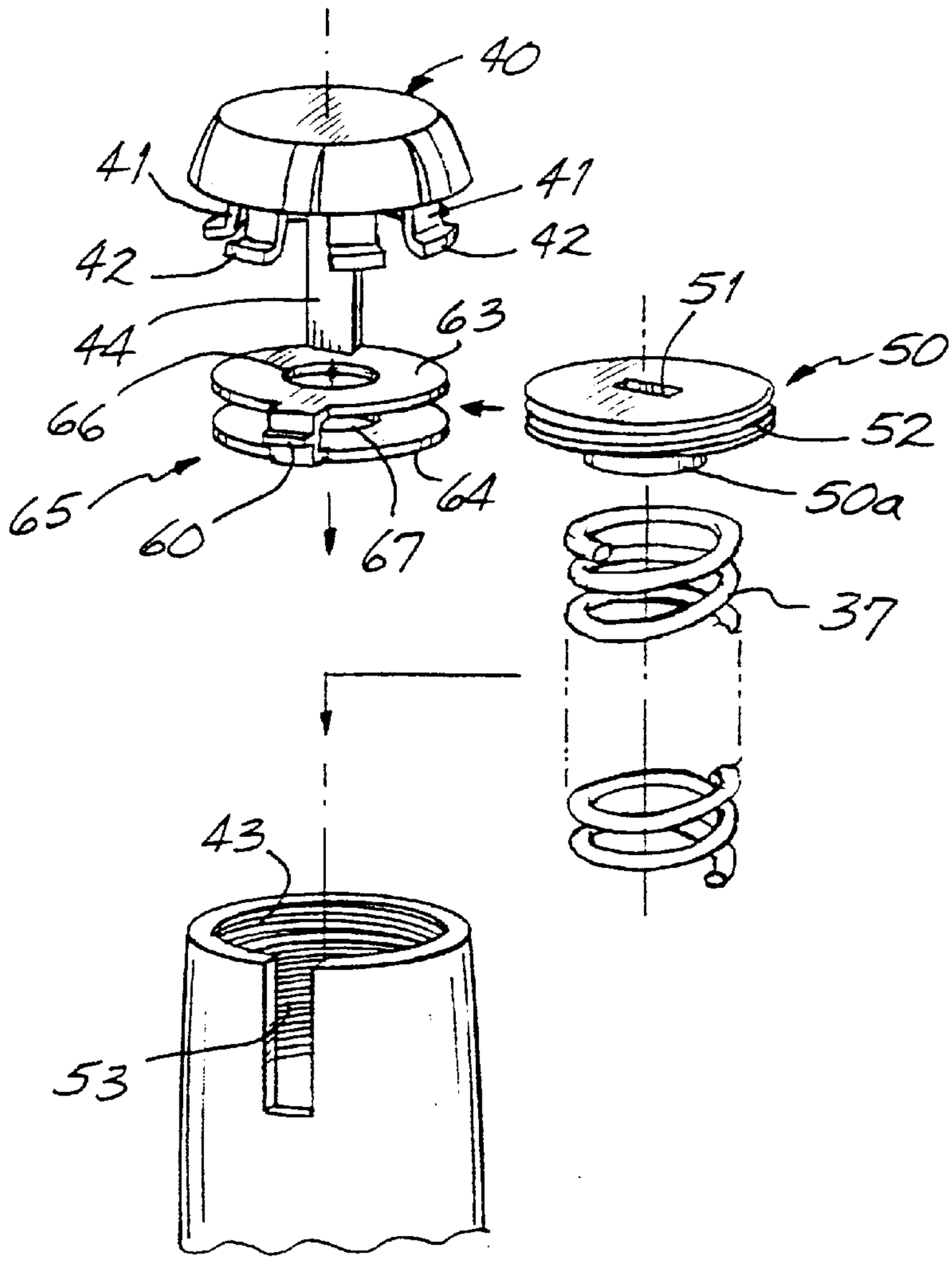

FIG. 5

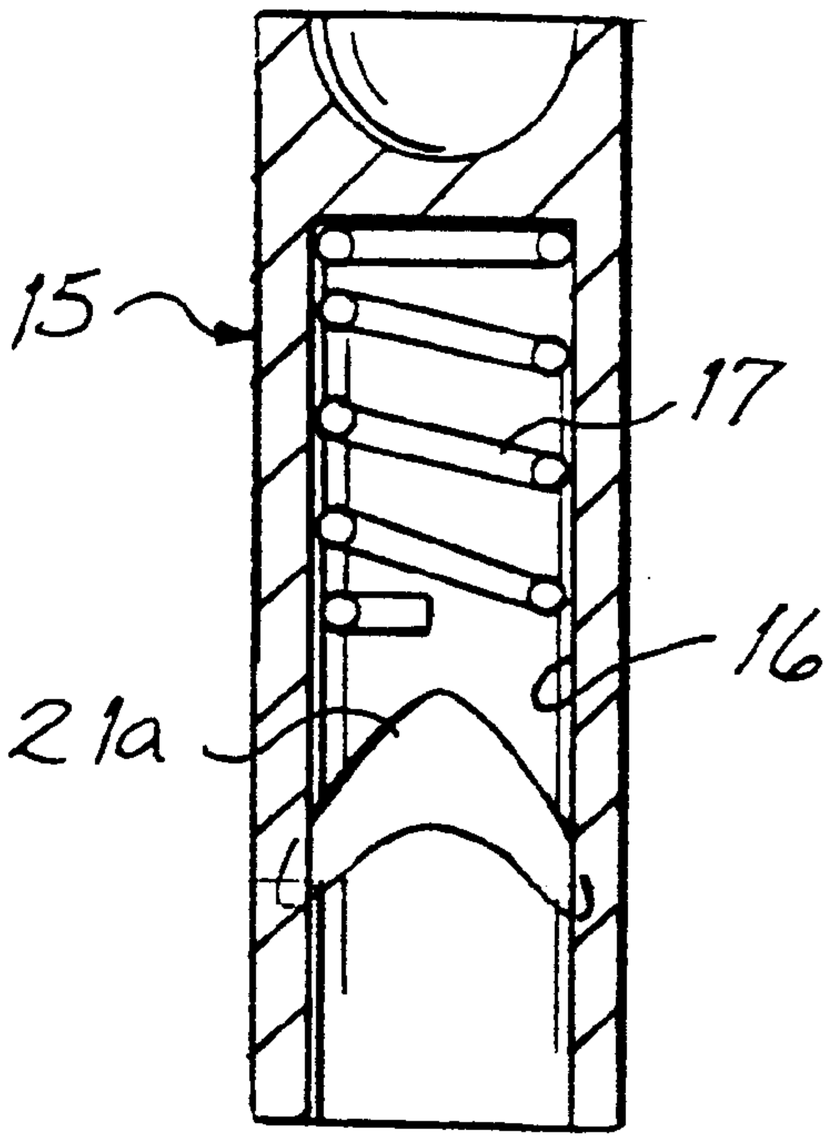

FIG. 6

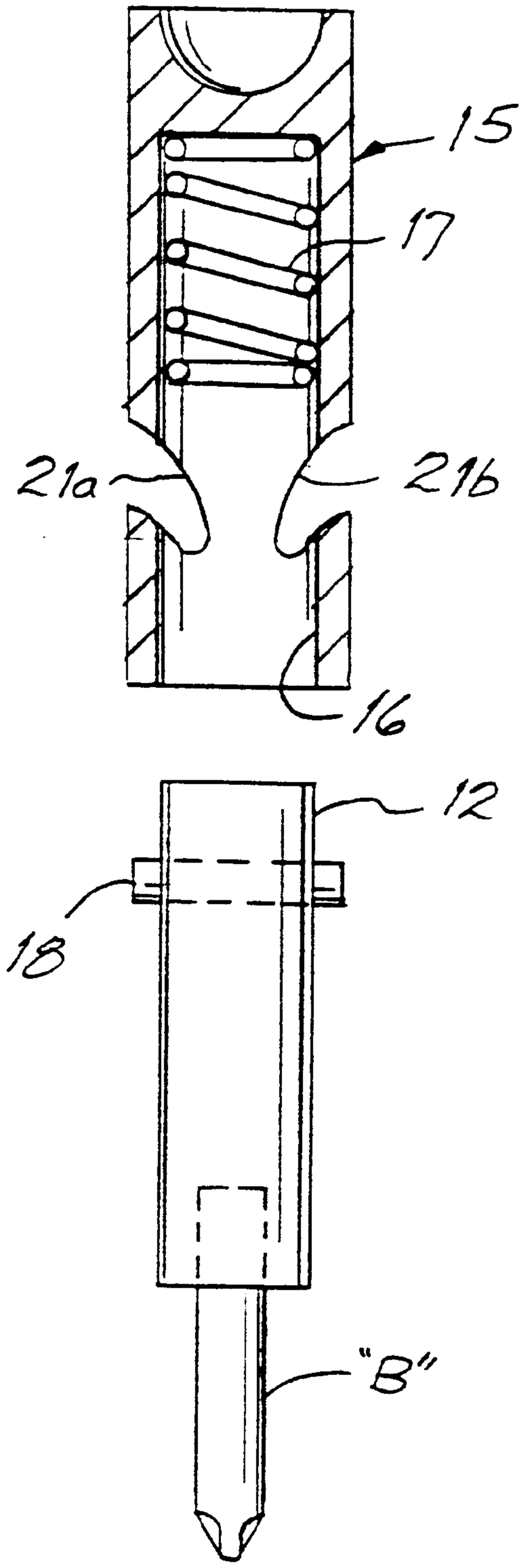

FIG. 7

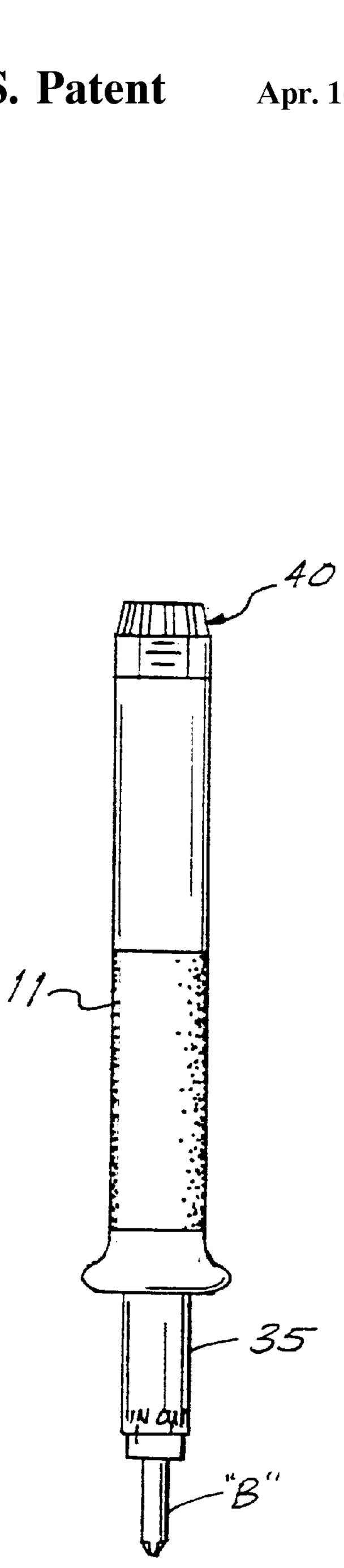

FIG. 8

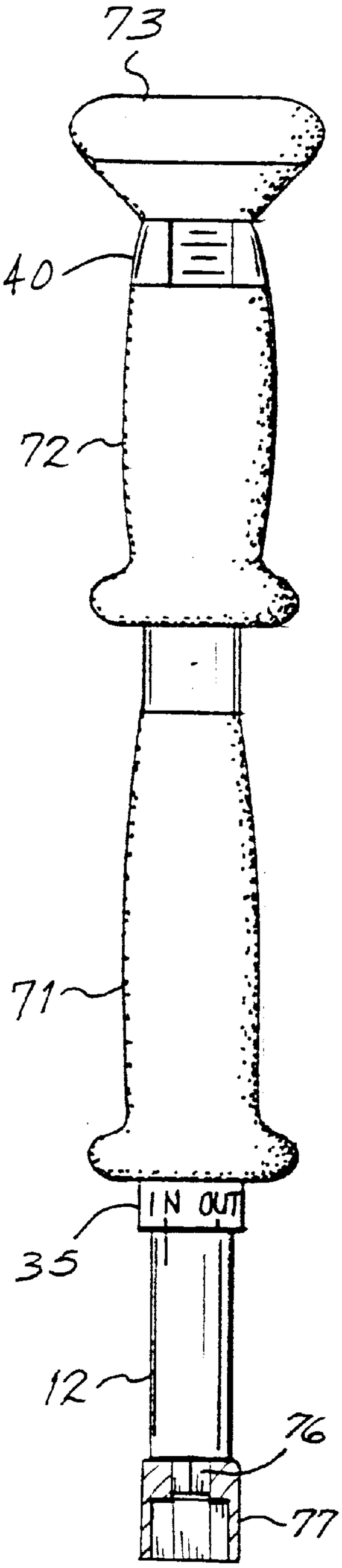

FIG. 9

SPRING LOADED SELF ACTUATING IMPACT DRIVER

Benefit is claimed of the filing date of Jul. 13, 1999 which is the filing date of applicant's provisional patent application, U.S. Ser. No. 60/143,583 entitled SPRING LOADED, SELF ACTUATING IMPACT DRIVER, which application is expressly incorporated herein by reference.

This invention relates to an impact driver and, more particularly, to an impact driver which does not rely on an external strike to cause the driver to operate.

Rotary impact drivers are well known. These are used to loosen or tighten fasteners which are stuck or which require significant torque in their operational placement or removal. In these devices, a durable handle houses a spring and a bit holder. A cam drives the bit holder.

When operated, a bit is inserted onto a fastener which may be a Phillips screw, a slotted screw, a hex head or any other rotary fastener for which a bit is provided. The rear end of the handle is struck by a discrete, manually-held mallet or hammer to provide a rotationally directed impact on the fastener. The blow serves to produce a force into the fastener as well as a rotational impact force thereon.

Depending on the size and other parameters of the fastener and its application, such a blow having the force of a discrete hammer or mallet may not be necessary. In many applications, while a rotational impact on the fastener is helpful, it may not require the extreme force of such a blow.

It is thus desirable to provide an impact apparatus which eliminates the necessity of striking an impact tool with a discrete hammer. It is another objective of the invention to provide an impact driver which is capable of imparting a rotational impact to a fastener but without a blow from a discrete hammer.

It is yet a further objective of the invention to provide a self-contained or self-actuating rotary impact driver where manipulation of the tool itself generates the rotational impact without requiring that the tool be struck by a hammer.

To these ends, an impact tool according to the invention includes an internal spring-loaded hammer within the tool. Manual compression of the tool toward a fastener loads the spring until a trigger mechanism releases the hammer to drive a cam housing forwardly and the associated bit holder both into the fastener and rotationally. Thus, a manual, linear pushing motion is converted into a rotational impact force. A manually adjustable screw mechanism is used to provide pre-load adjustment for the hammer spring. Also, a reversing apparatus is operable by manual rotation of the bit housing to reverse the rotary impact direction to selectively create forward or reverse drive direction for the same manual actuating push toward the fastener.

These and other objectives and advantages will become readily apparent from the following detailed description of a preferred embodiment of the invention and from the drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view illustrating the tool of the invention;

FIG. **2** is a cross-sectional view illustrating details and components of the tool of FIG. **1**;

FIG. **3** is a partial elevation a view of the upper end of the handle of the tool of FIGS. **1** and **2**;

FIG. **4** is a cross-sectional view of the components of FIG. **3**;

FIG. **5** is an exploded view of the components of FIGS. **3** and **4**;

FIG. **6** is a cross-sectional view of the cammed housing and bit housing of FIGS. **1** and **2**;

FIG. **7** is a cross-sectional view similar to FIG. **6** but shown at 90 degrees with respect thereto;

FIG. **8** is an elevational view of a small driver according to the invention; and

FIG. **9** is an elevational view of a larger impact driver according to the invention.

Turning now to the figures, there is shown in FIG. **1** a self-contact impact tool **10** according to the invention and having a soft handle **11** and an outer housing **35** extending forwardly therefrom. A rotational bit housing **12** extends forwardly of outer housing **35** and releasably mounts on an appropriate driver bit or socket such as bit "B". Fastener out and fastener in markings (FIG. **1**) are applied to the outer housing **35** for indexing with a mark **13** on the rotational bit housing **12**.

Internal components of tool **10** are best seen in FIGS. **2–7**. Outer housing **35** is preferably secured to handle **11** by threads illustrated at **14**. Handle **11** is hollow, as is outer housing **35**.

A cammed housing **15** (FIGS. **6–7**) has a bore **16** housing a compressible shock spring **17** of any appropriate gauge and coil number. Rotational bit housing **12** is disposed within cammed housing **15** capturing shock spring **17** therein.

Helical or other shaped slots **21***a* and **21***b* are provided on opposite sides of cammed housing **15** and receive a pin **18** extending through rotational bit housing **12**. Pin **18** moves into one side or the other of the respective helical slots **21***a*, **21***b* by manual selection to select either clockwise or counterclockwise rotation of rotational bit housing upon operation of tool **10** as will be described.

One or more sets of splines or grooves **22** are disposed in the forward end of the outer housing **35** to cooperate with one or more external splines (not shown) or grooves on the cammed housing **15** to enable it to translate axially, but not move rotationally. When the tool is assembled, shock spring **17** urges the bit housing **12** in a forward direction from cammed housing **15**.

A push trigger **19** (FIG. **2**) has a rounded engagement nose **23** and a rearwardly directed flat or rod-like stem **24** extends rearwardly from a centering boss **25** on the trigger **19** to an end **29**. Boss **25** has a frusto-conically shaped surface **26**. A trigger spring **27** urges the stem **24** in a radial, off-axis direction, toward an internal wall of the outer housing **35**.

The soft handle **11** houses an internal hammer **20** and hammer spring **37**. Hammer **20** has an axially extending bore or slot **28** preferably corresponding in shape with stem **24** of trigger **19**. Bore **28** has a blind end **32**. Hammer **20** includes a face **30** and provides a hammer stop surface for engagement with shoulder surface **33** in handle **11**. Handle **11**, as shown in FIG. **2**, also incorporates a tapered seat **31** preferably configured similar to surface **26** on trigger **19**, as will be described.

At the forward end of the tool, a magnetic bit receiver **36**, or any other form of bit receiver, is attached to the rotational bit housing **12**. When that housing rotates, it carries the bit receiver **36** and any bit "B" or socket therein in the same direction, motivated by slot **21***a* or **21***b* and the cammed pin **18**.

Referring to FIGS. **3–5**, the tool's soft handle **11** is provided with an adjusting knob **40**. Knob **40** is provided

with a plurality of tabs **41**, each having an outwardly turned flange **42**. Flanges **42** ride in a groove **43** provided in the interior cylindrical surface of the handle to capture it. The knob **40** is rotatable, but is not movable in an axial direction along the elongated axis of the tool **10**.

A drive blade or tab **44** extends axially into the tool handle from knob **40**. Blade **44** is a flat-shaped member preferably, but other shapes could be used.

An externally-threaded spring compressor disk **50** is provided with a slot-shaped aperture **51** for receiving blade **44**. When knob **40** and thus blade **44** turn, the disk **50** is rotated.

Disc **50** is provided with external threads **52** cooperating with internally facing threads **53** in the handle **11**. When knob **40** and disc **50** turn, the disc **50**, but not the knob **40**, translates or moves in an axial direction along the elongated axis of the tool. Of course, the disc **50** moves axially along the blade **44**.

Movement of the disc **50** toward the hammer spring **37** compresses and pre-loads that spring **37** so that its eventual force is increased. Movement of disc **50** in an opposite direction unloads the hammer spring **37** so that its eventual force is decreased. A shoulder, **50***a,* on disc **50** is inserted in the end of the hammer spring **37**, acting as a spring guide to keep that spring centered.

In order to indicate the degree of pre-load on the hammer spring, a pre-load indicator **60** is disposed in an extended slot **61** in the handle and through the handle wall.

Indicator **60** is preferably formed integrally as a connector between two washer-shaped members **63**, **64** defining, with indicator **60**, an indicator collar **65**. The circumference and diameter of disc **50** is such that it generally extends slightly outwardly (radially) from the outer circumferential edges of washers **63**, **64**. Disc **50** resides between washers **63**, **64** and is free to rotate with respect thereto.

Washer members **63**, **64** are provided with apertures **66**, **67** to accommodate blade **44** without turning when the blade **44** turns, and collar **65** is translatable axially.

Since the indicator **60** rides in slot **61**, since washer members **63**, **64** are less than coextensive with disc **50**, and since the collar **65** can move axially, rotation of knob **40** to turn blade **44** and move disc **50** axially, also causes indicator **60** to move in a direction parallel to the elongated tool axis. Markings on the handle next to slot **61** (FIG. **3**) thus indicate the position of indicator **60** and the high, medium or low pre-load condition of the hammer spring **37** as a function of the position of disc **50** in the handle and with respect to the position of the loaded or unloaded spring **37**.

The driver can be made in any suitable size. In one configuration (with similar numbers for similar parts), it can be pencil-sized (about 5½ inches long) for small work, jewelry, watches, glasses, etc. In another application (with similar numbers for similar parts), it can be made larger (about 14 inches long) and provided with two hand grips **71**, **72** around its handle, a body or knee pad **73** on the handle end for application of higher force, and a 3/8 or ½ inch square drive end **76**. (FIG. **9**) for a socket **77**, for example. In both embodiments, similar hammer spring pre-load adjustment structure can be used, or any other suitable adjustment mechanism for adjusting the pre-load on spring **37**.

Turning to the operation of the invention, the hammer spring **37** is pre-loaded to a desired condition (less than the preset pre-load of the shock spring **17**). An appropriate bit "B" or socket is selected and mounted and the tool **10** positioned over the workpiece or fastener.

The tool is then manually pushed toward the fastener. This motion compresses the hammer spring **37** by virtue of the engagement of the rear end **29** of stem **24** on the forward face **30** of the hammer. The trigger spring **27** is also compressed. It will be appreciated that during this compression, the handle **11** and outer housing **35** are moved forwardly over the rotational bit housing **12**, causing the handle **11** to turn slightly as it moves forwardly, depending on the slope of respective slot **21***a* or **21***b* in which pin **18** resides.

When the tool **10** is substantially forward, with spring **37** compressed, the centering boss **25** of trigger **19** is moved into the tapered seat **31**. This axially indexes stem **24** against the bias of the trigger spring **27** and into a coaxial position with respect to the tool **10** and, more importantly, bore **28** in internal hammer **20**. When the end **29** of stem **24** is axially oriented, it falls off the face **30** of the hammer **20** into slot or bore **28**. The hammer is released and falls onto the stem **24**. When the end **29** of stem **24** is hit by the blind end **32** of the slot or bore **28** of hammer **20**, the stem **24** and nose **23** thereon are driven forwardly by the force of the pre-loaded and now compressed hammer spring **37**. This forward blow or impact force is transmitted through the stem **24** to nose **23** and to the cammed housing **15** which is driven sharply forwardly, and rotationally depending on which side of slots **21***a,* **21***b* pin **18** resides.

Of course, any suitable mechanism could be used to compress and release the hammer **20** on manual operation of the handle **11**. Likewise, any centering device such as a ramp, or other centering mechanism or release mechanism for the trigger stem **24** could be used.

As the cammed housing **15** is moved forwardly, it is restrained from rotation by its external spline or splines **22**. Slots **21***a,* **21***b* also move forwardly with the cammed housing and drive the cammed pin, rotational bit housing **12**, bit receiver **36** and bit "B" therein rotationally with an impact force which is imparted to the fastener. The hammer **20** may be arrested in its forward motion by its face **30** and shoulder **33**.

Once the stem end **29** clears the slot or bore **28** (the trigger spring **27** biases it forwardly) the radial bias of the trigger spring **27** moves the stem **24** in a radial direction, offsetting it axially and from slot or bore **28** as show n in FIG. **2**, and resetting the tool **10** for another cycle.

Since the hammer spring **37** is pre-loaded less than the shock spring **17**, the hammer spring is compressed by manipulation of the tool. When the hammer is released to fall on the stem **24**, the force or blow is thus cushioned by the shock spring. Selection of hammer spring **37** and shock spring **17** are thus selected as a function of the typical impact drive operation to be produced and can be of any suitable cooperating parameters.

Of course, various bits, tool sizes and components can be used for particular applications. Also, slots **21***a* and **21***b* can be inclined or configured for providing particular rotational driving parameters. Reversal of the drive direction is produced by twisting the rotational bit housing to line up index mark **13** with the appropriate indication on housing **35** (FIG. **1**). Preferably the two slots have a common area to allow positioning of the cammed pin in the selected slot for rotation in the proper direction. As described, markings on the respective outer housing **35** and on the rotational bit housing indicate whether the tool operation will turn a bit "in" toward (forward) the workpiece or "out" away from the workpiece (rearward).

In summary, the primary purpose or function of the spring loaded impact driver is the removing or driving of fasteners

that are difficult or stuck and require a high degree of torque or impact shock, but yet preferably without an external blow. The tool allows a push motion to be converted into a rotational impact force.

The push motion loads an internal spring. At a preset location, a trigger mechanism releases the loaded spring driving a hammer. The hammer then strikes an internal cammed housing creating a rotational impact shock. The driver design allows for multiple driver and bit configurations. The driver has a manually adjustable screw mechanism which allows the user to change the hammer spring pre-load. The driver bit housing can be rotated in order to create a forward or reverse drive direction. Also, handles **11**, **71**, **72** can be of any suitable material, such as soft synthetic or rubber compound.

These and other modifications and advantages will become readily apparent to those of ordinary skill in the art and applicant intends to be bound only by the claims appended hereto.

I claim:

1. A rotary impact tool for driving fasteners and comprising:

a handle;

an outer housing;

said handle and said outer housing being screwed together;

a spring-loaded hammer disposed for reciprocating movement within said handle;

a cammed housing disposed in said outer housing and having a cam slot, said cammed housing movable axially but not rotationally in said outer housing; a

bit housing;

a pin extending from the bit housing into said cam slot; and

a trigger comprising an elongated stem for urging said spring-loading hammer into a compressed condition when said tool is manually pushed toward a fastener, and for releasing said hammer to drive said cammed housing and impart a rotational impact force to said fastener through said bit housing;

said hammer remaining within said handle throughout its reciprocating movement.

2. A rotary impact tool as in claim **1** wherein said trigger stem is offset axially for compressing said spring-loaded hammer and further including a centering means for axially aligning said stem to release said hammer.

3. A rotary impact tool as in claim **2** including a yieldable spring biasing said trigger stem into an offset axial position.

4. A rotary impact tool as in claim **1** including an adjustment knob and an indicator proximate the handle to adjust and indicate, respectively, a spring pre-load on the hammer.

5. A rotary impact tool as in claim **1** including respective indicia on the bit housing and on the tool cooperating to indicate operational tool direction, upon release of said hammer.

6. A rotary impact tool as in claim **2** wherein said centering means comprises, in part, a tapered surface defined within an area overlapped by said handle and by said outer housing.

7. A rotary impact tool as in claim **6** wherein said handle includes an inner cylinder, said tapered surface comprising a portion of said inner cylinder.

8. A rotary impact tool as in claim **7** further including a hammer stop defined in an end of said inner cylinder.

9. A rotary impact tool as in claim **1** further including an inner cylinder in said handle, said inner cylinder having a distal end comprising a hammer stop and further also comprising a hammer stop and further also comprising a portion of a means for centering said stems to release said hammer.

* * * * *